Fourth EAGE Workshop on High Performance Computing for Upstream

HPC THROUGH THE 4TH INDUSTRIAL REVOLUTION

7-9 OCTOBER 2019 • DUBAI, UNITED ARAB EMIRATES

Technical Programme
WORKSHOP OVERVIEW

Comparing across multiple industries, our energy business undoubtedly exploits the largest High-Performance-Computing capacity. HPC plays a central role in seeking higher productivity, lowering costs and making better use of our data through high-performance simulation and data analytics. This is especially true while our industry experiences change through this fourth industrial revolution (4IR): digitalization. Algorithms performing as fast as possible on the best available hardware either on premise or in the cloud have a direct role and impact on many of the decisions shaping our business. The overlap and cross pollination opportunities between data analytics, big data, AI, simulation and HPC is the underlying theme of this fourth instance of our HPC workshop: HPC through the 4IR.

Upstream simulation and modelling is our principal mechanism for the accurate location of hydrocarbons and their optimal production. The reliance on data for making better business decisions at a lower cost is becoming critical. Seismic data are explored using traditional imaging algorithms such as Reverse Time Migration (RTM), Full Waveform Inversion (FWI) and Electromagnetic Modeling (EM) to illuminate the hidden subsurface of the earth and reservoir simulation is used to optimally produce fields and predict the time evolution of assets. Both are highly compute-intensive activities, which push the leading edge of HPC storage, interconnect and calculation. The industry is evolving on several fronts. Changes in the underlying hardware with the advent of coprocessing technologies and many-core CPUs are challenging practitioners to develop new algorithms and port old ones to reap the most performance from modern hardware. The explosion of data and the recent rapid development in machine learning (ML) are leading to non-traditional ways of interpreting seismic and reservoir data. The emergence of significantly faster reservoir simulation technology is breathing new life into multi-resolution and uncertainty quantification workflows.

The ability to create and mine these data relies on the optimal utilisation of supercomputers. This is the result of various synergies between industries, companies, departments and, most importantly, people. HPC IT departments (or even HPC cloud solution providers) are focused on minimising turnaround times for various workloads, but also deploy the various compute architectures in a cost competitive fashion while adapting to the fast-paced innovation in the semiconductor industry. Research groups and software application teams in both academia and industry develop new algorithms and keep abreast with the latest while adapting and optimizing existing or new production frameworks to the latest parallel programming model, language and architecture. The workshop brings together experts in order to understand state-of-the-art key applications employed in the upstream industry and anticipate what ambitions are enabled by increased computational power.

The 3-day workshop will feature both oral & poster presentations, discussion sessions and keynotes from the leading experts in the industry, as well as insightful and interesting short courses embedded into the workshop technical programme.

TECHNICAL PROGRAMME

Oral Presentations | Monday 7 October

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
<th>Title</th>
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<tbody>
<tr>
<td>08:00</td>
<td>Registration &amp; Welcome Coffee</td>
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<td>08:30</td>
<td>HSE from Hotel</td>
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<td>08:35</td>
<td>Chair Welcome</td>
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<tr>
<td>08:45</td>
<td>Keynote: The Convergence of Big Data and Large-scale Simulation</td>
<td>David Keyes (KAUST)</td>
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<tr>
<td>09:30</td>
<td>Seismic Modelling &amp; Imaging - Part I</td>
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<td>10:00</td>
<td>Performance Analysis &amp; Optimization - Part I</td>
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<td>10:30</td>
<td>Coffee Break</td>
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<td>11:00</td>
<td>HPC03 - A Checkpoint of research on the implementation of geophysical stencils on multicore platforms.</td>
<td>F. Dupros*, C. Hillairet*</td>
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<tr>
<td>11:30</td>
<td>HPC04 - Saving FLOPs in Geophysics with optimal p-adaptivity</td>
<td>V. Etienne*</td>
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* Saudi Aramco, EXPEC Advanced Research Center
12:00 HPC05 - Alleviating the pressure on memory for seismic modeling - R. Abdelkhalak, H. Ltaief, V. Etienne, K. Aktubad, T. Tornell, D. Keyes
1 Extreme Computing Research Center, King Abdullah University of Science and Technology; 2 EXPEC Advanced Research Center, Saudi Aramco

12:30 Lunch

14:00 Breakout Session: HPC Technology Evaluation and Benchmarking - Andrew Jones (NAG)

15:45 Coffee Break

16:15 Keynote: Robert Sutor (IBM)

17:00 Wrap-up Discussion

17:15 End of Day 1

Oral Presentations | Tuesday 8 October

08:00 Morning Coffee

GRAND BALLROOM

08:30 Keynote: Felix J. Herrmann (Georgia Institute of Technology)

Emerging HPC Technologies - Part I
Session Chairs: P. Demichel (HPE), A. Alturki (Saudi Aramco)

09:15 HPC06 - Automated Distributed-memory Parallelism from Symbolic Specification in Devito - F. Luporini, R. Nelson, T. Burgess, A. St-Dyr, G. Gorman
1 Imperial College London; 2 DownUnder GeoSolutions; 3 Shell

09:45 HPC07 - Total takes the deep dive into GPU for Seismic Imaging - L. Boillot, D. Klahr, L. Qui, X. Lacoste, M. Bonnasse-Gahot, J. Montel, E. Bergounioux, J. Briche
1 Total

10:15 Coffee Break

Performance Analysis & Optimization - Part II
Session Chairs: J. Phillips (ExxonMobil), F. Dupros (ARM)

10:45 HPC08 - CGG: A Journey from Software to Hardware - V. Anslan*, F. Pautre, J. Blanch, T. Barragy
1 CGG

11:15 HPC09 - Weak scalability analysis of GPGPU-based iterative solvers in a two-phase pore-scale flow simulator - C. Thiele, M. Araya-Polo, A. Alpak, B. Riviere, D. Hoff
1 Rice University; 2 Shell International Exploration & Production, Inc.

11:45 HPC10 - Scalable High-Resolution Seismic Tomography - L. Boillot, P. Basini
1 Total

12:15 Lunch

Emerging HPC Technologies - Part II
Session Chairs: S. Feki (King Abdullah University of Science & Technology), G.Y. Youinou (CGG)

12:45 Keynote: Full application, Full system prediction. Where are we exactly and what to expect. - Phillippe Thierry (Intel)

14:30 HPC11 - Seismic Processing with Hybrid HPC - P. Souza Filho, A. Sardinha, C. Ávila, A. Azambuja, F. Sierra, N. Ji
1 Atrio Inc; 2 Petrobras

15:00 HPC12 - Potential applications of quantum computing in upstream - M. Dukalski
1 Aramco Overseas Company B.V.

15:30 Coffee Break

16:00 Panel Discussion: Opportunities & Challenges in HPC for Oil & Gas
1 Patrick Demichel (HPE), Fabrice Dupros (ARM), Shintaro Momose (NEC), Issam Said (Nvidia)
2 Andrew Jones (NAG)

16:45 Wrap-up Discussion

17:00 End of Day 2

19:30 Workshop Dinner

Oral Presentations | Wednesday 9 October

08:00 Morning Coffee

GRAND BALLROOM

09:00 Keynote: Reservoir Simulation in the Fourth Industrial Revolution - Suha Kayum (Saudi Aramco)

Reservoir Modelling & Simulation / Digital Rock Physics
Session Chair: V. Natoli (Stone Ridge Technology)

09:45 HPC13 - 3D simulation of active–passive tracer dispersion in polygonal fractured geometries - S. Khirevich, T. Patzek
1 King Abdullah University of Science and Technology

1 Saudi Aramco

10:45 Coffee Break

Seismic Modelling & Imaging - Part II
Session Chairs: I. Said (NVIDIA), P. Thierry (Intel)

1 Brightskies Inc; 2 Intel

11:45 HPC16 - A GPGPU pipeline for fast synthesis of 3D seismic - S. Moore, A. Costa Nogueira Junior, J. Hoffman, M. Paredes Quinones, J.L. Sousa Almeida
1 IBM Research Brazil; 2 IBM Research Australia

12:15 Lunch

13:45 Breakout Session: Quantum Computing 101 - IBM

15:30 Best Presentation Recognition Award

15:45 End of Workshop

Poster Presentations

GRAND BALLROOM FOYER

POS01 - Incorporating Lossless Compression in Parallel Reservoir Simulation - N. Rogovski (Saudi Aramco), S.N. Kayum (Saudi Aramco), F. Mannnus (Saudi Aramco)

POS02 - Digital Twin of Multiscale Geological Media: Faults, Fracture Corridors, Caves. Seismic simulation and imaging - V. Cheverda (Trofimov Institute of Petroleum Geology & Geophysics SB RAS), G. Reshetova (Trofimov Institute of Petroleum Geology & Geophysics SB RAS), V. Lisitsa (Trofimov Institute of Petroleum Geology & Geophysics SB RAS), M. Protasov (Trofimov Institute of Petroleum Geology & Geophysics SB RAS)

POS03 - A Scientific Workflow for Reverse Time Migration under Uncertainty - C.H. Barbosa (Federal University of Rio de Janeiro)*, B. Silva (Federal University of Rio de Janeiro), C. Alves (Federal University of Rio de Janeiro), R. Silva (Federal University of Rio de Janeiro), L. Kunstmann (Federal University of Rio de Janeiro), H. Costa (Federal University of Rio de Janeiro), J. Alves (Federal University of Rio de Janeiro), M. Mattoso (Federal University of Rio de Janeiro), F. Rochinha (Federal University of Rio de Janeiro), D. Filho (Petrobras), A. Coutinho (Federal University of Rio de Janeiro)

POS05 - Exposing Fine-Grained Parallelism in Sequential Gaussian Simulation - M. Khair (TU Delft)*, K. Estler (Stone Ridge Technology)

POS06 - GPU Implementation of Line Solve Power Series Preconditioner used in Reservoir Simulation - O. Hajjar (Saudi Aramco)*, M. Al-Hezam1, K. Dai
1 Saudi Aramco

POS07 - Accelerating seismic parameter estimation with Adaptive Differential Evolution (JADE) and graphics processing units (GPUs) - J. Ribeiro (CEPETRO / UNICAMP)*, N.T. Okita (CEPETRO / UNICAMP), T.A. Coimbra (CEPETRO / UNICAMP), M. Rogowski (Saudi Aramco)

POS08 - High-Performance Computing Applications Transition to the Cloud in Upstream - S. Kayum (Saudi Aramco)*, M. Rogowski (Saudi Aramco)
BEST PRESENTATION RECOGNITION AWARD

The Technical Committee will be selecting one oral presentation to receive a recognition award, as well as the opportunity for the author to have their abstract published in First Break. The winner will be announced at the end of the workshop.

VENUE DETAILS

Grand Plaza Mövenpick Media City
Sheikh Zayed Road, opposite Innovation Hub
Media City
Dubai, United Arab Emirates

REGISTRATION

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*Memberships are provided for Non-Member registrations and the activation will only take place after the event, between 2-3 weeks.

All fees are in Euros (€). One Euro of your total registration fee is donated to the EAGE Green Fund. Please note that all fees are subject to 5% VAT as per UAE regulations. Members please note: To qualify for the member registration fee, your EAGE membership dues for 2019 must have been paid and confirmed. The processing time for membership applications or renewals is 10 working days.

- EAGE registration fees differentiate between EAGE membership recognition levels and non-members. First year members have Green membership status which gives you a € 50 discount (€ 25 for students) on the Non-member fee for each EAGE event registration; starting from Bronze status, you can benefit from an even greater reduced EAGE member registration fee. Please visit the EAGE website for more information about the recognition programme.

SOCIAL PROGRAMME

Icebreaker Reception
Sunday 6 October 18:00-20:00
Twenty Three Rooftop Bar @ Grand Plaza Mövenpick Media City

Workshop Dinner
Tuesday 8 October 19:30
Folly by Nick & Scott
Madinat Jumeirah
Transport to and from the dinner will be provided by EAGE (buses will leave at 19:00 from the hotel and return at 21:30 and 22:30 respectively)

SPONSORSHIP

We would like to thank the workshop sponsors:

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  NEC

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- Lanyards
  Hewlett Packard Enterprise

- Icebreaker
  Total

- Registration desk
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